

NASA SCIENCE MISSION DIRECTORATE

Earth-Sun System Applied Sciences Program Energy Management Program Element FY 2005-2009 Plan



Version 1.1

March 16, 2005



*Expanding and accelerating the realization of economic and societal
benefits from Earth-Sun System science, information, and technology*

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NASA Science Mission Directorate
Earth-Sun System Division
Applied Sciences Program

Applied Sciences for the Energy Management Program Element

This document contains the Energy Management Program Element Plan for Fiscal Years 2005-2009. This plan derives from direction established in the NASA Strategic Plan, the Earth Science Enterprise Strategy, the Space Science Enterprise Strategy, the Earth Science Applications Plan, and OMB/OSTP guidance on research and development. The plan aligns with and serves the commitments established in the NASA Integrated Budget and Performance Document.

The Program Manager and the Applied Sciences Program leadership have reviewed the plan and agree that the plan appropriately reflects the goals, objectives, and activities for the program element to serve the Applied Sciences Program, the Earth-Sun System Division, NASA, the administration, and society.

(Signature on file)

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February 11, 2005

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NASA Earth-Sun System Division – Applied Sciences Program Energy Management

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NASA Science Mission Directorate – Applied Sciences Program

Energy Management Program Element Plan: FY 2005 - 2009

I. Purpose and Scope

This plan articulates the goals and direction of the Energy Management Program Element for the period from Fiscal Year (FY) 2005 to 2009 by detailing the purpose of the program and our strategy to fulfill the Energy Management mission with the resources available. The plan describes the Program's scope, including NASA's role in partnerships, the focus on decision support tools, and the types of science research results we seek to extend. Within the Earth-Sun System Division, this plan functions as a program management tool, describing the program structure, functional mechanisms, performance measures, and general principles that the Energy Management activity will follow. The plan includes projects in which science research results can be applied to decision making with related socioeconomic benefits.

In the 21st century there are many challenges facing society such as clean water, adequate food supplies, human health, economic growth and expansion, and the preservation of the environment just to name a few. Solutions to many of these challenges are more easily achieved when affordable, reliable and secure energy supplies are available for the global community. Forecasts of long-term energy demand suggest multi-fold increases in world energy consumption during the 21st century, driven by expanding population and economic development. Well-informed policies and management decisions regarding energy production and its efficient use are paramount to ensure sustainability and prosperity for all in the global community. These same policies and decisions also need to account for the impact of energy production and energy consumption on the environment and climate change.

In response, the Administration, through the establishment of the Climate Change Science Program (CCSP) and the Climate Change Technology Program (CCTP) has called for the focusing of U.S. efforts in addressing climate change and established the approach to support the nation and the global community with the science-based knowledge to manage the risks and opportunities of change in the climate and related environmental systems and the impacts on societal infrastructures, such as energy supply and demand.

Internationally, the Intergovernmental Panel on Climate Change (IPCC), established by the World Meteorological Organization (WMO) and the United Nations Environmental Programme (UNEP), assesses scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation across many elements of society. More specific to energy, UNEP's Energy Programme addresses the environmental consequences of energy production and use, such as global climate change and local air pollution and supports decision makers in government and the private sector to make better, more informed energy choices which fully integrate environmental and social costs.

Federal Departments such as Energy, Interior, Agriculture, Commerce, and Transportation, and Agencies, such as the Environmental Protection Agency (EPA), have primary responsibilities in

the United States for forming policies and regulations concerning energy production, efficient energy consumption and conservation, and the monitoring and regulation of impacts from these activities on the environment. There are numerous organizations within the Energy sector that provide information to improve the sector's operations and responses to policies and regulations. These same federal agencies, departments and sector organizations participate in an international community that seeks many of the same goals as are found in the U.S. sector and desire to benefit from experiences gained in U.S. programs to enable their own energy sectors.

As part of the NASA mission "To understand and protect our home planet," NASA implements the Energy Management Program Element of the Applied Sciences Program by partnering with federal and private organizations to improve their decisions and assessments that impact the Energy sector. These improvements are enabled by leveraging the Earth-Sun System knowledge generated from research resulting from spacecraft observations and model predictions conducted by NASA and providing these as inputs to the decision support and scenario assessment tools used by partner organizations. The Energy Management Program Element focuses its efforts to provide for improved decisions and assessments for the following primary areas:

1. Energy production
2. Energy efficiency

The Element will maintain alignment with Administration priorities, specifically the CCTP, CCSP, and IWGEO, by leveraging activities in the primary areas as they apply to the measuring and monitoring of greenhouse and other gases as well as carbon sequestration as related to the energy sector.

The approach of the Energy Management Program Element is to develop information pathways from NASA spacecraft observations and Earth-Sun system modeling to decision support tools (DST)¹ supporting energy demand and availability in industry and government entities. These entities require historical, near-real time, and forecasted environmental observations as inputs to the DST for management decisions and scenario assessments for policy. NASA works with its partners to identify the physical quantities provided by NASA observations and model predictions resulting from Earth science research, which are specifically selected, derived, and formatted to meet the needs of a specific DST. The Energy Management Program Element leverages the NASA Science Mission Directorate (SMD) observations and predictions produced from seven research themes. The leveraged themes are:

1. Atmospheric Composition
2. Carbon Cycle and Ecosystems
3. Climate Change and Variability
4. Water and Energy Cycles
5. Weather
6. Sun-Solar System Research
7. Earth Surface And Interior

¹ *Decision Support Tools – a suite of solutions owned by NASA partners that are used in a variety of problem domains for decision and policymaking. These solutions could include assessments, decision support systems, decision support calendars, etc.*

Roadmaps for the Earth-Sun System Research themes are found in the Earth Science Enterprise Research Plan located at the web address <http://science.hq.nasa.gov>.

To facilitate the approach of the Energy Management Program Element, a basic three-step process has been adopted in order to evaluate, verify and validate, and benchmark Energy Management Applications with its partners:

1. *Evaluation Research*: Study the overall energy field, identify various industry sectors, and identify the corresponding government agencies that contribute to these sectors. Assess the field needs and as necessary, create and validate rapid prototype datasets that address those needs.
2. *Partner*: Make contact and build partnerships with prospective DST developers and data users in government and industry. Increase exposure to industry sector and interact with industry engineers and scientists.
3. *Specialize*: Interact with partners to develop prototype datasets to better meet the Energy Sector needs. Cultivate new users. Upgrade the capabilities and parameters as new analysis and modeling techniques are developed and improved.

As an example, this process was applied to the solar and wind industries in the development of a highly successful web based solution called the Surface meteorology and Solar Energy (SSE) data set (<http://eosweb.larc.nasa.gov/sse>). To develop this data set, NASA climate researchers worked in partnership with the Department of Energy/National Renewable Energy Laboratory (DOE/NREL), the Canadian Meteorological Service (CANMET) Energy Diversification Research Laboratory (CEDRL), and several small solar and wind companies to produce specific parameters needed by industry engineers. A direct link between the SSE website and CEDRL's renewable energy decision support system decision support system (DSS)² called RETScreen (www.retscreen.net) enabled access for a broader user community. Since its inception, the SSE website has received nearly 2.5 million hits, 520,000 data document downloads and over 10,000 unique users.

The desired outcome of the Energy Management Program Element is for partner organization to use the project results, such as guidelines, prototypes and procedures as benchmarks for operational use and to enhance their management and decision-making capabilities with appropriate Earth-Sun system products and tools. This Energy Management Program Element plan describes the activities for a systematic approach to evaluate, verify, benchmark, and extend the use of Earth-Sun System science knowledge, data, and technology to support partners' energy-related decision support tools and management responsibilities.

² *Decision Support System (DSS) – a computer based information-processing system for scenario optimization through multi-parametric analysis. A DSS utilizes a knowledge base of information with a problem solving strategy that may routinely assimilate measurements and/or model predictions in support of the decision making process. The DSS provides an interface to facilitate human inputs and to convey outputs. Outputs from a DSS would typically be used for making decisions at the local level and outputs from multiple DSS may be used in establishing policy.*

Scope within NASA and Applied Sciences Program

The Energy Management Program Element is managed in accordance with, and is guided by, the NASA Strategic Plan and Earth Science Enterprise Strategy. The program element benefits from Earth-Sun system science results and capabilities including Operation System Simulation Experiments (OSSEs), Project Columbia, the Joint Center for Satellite Data Assimilation (JCSDA), the Earth-Sun System Gateway (ESG), and the Transition from Research to Operations (R2O). The program element utilizes initiatives such as the Global Information Grid (GIG) and Federal Enterprise Architecture (FEA) and cooperates with national Earth-Sun laboratories and international programs.

The FY05 President's Budget for the NASA Applied Sciences Program* specifies \$54M annually for FY05-FY09 for the National Applications (\$24M) and Crosscutting Solutions (\$30M) activities. While directly managing a subset of the \$24M National Applications budget, the Energy Management Program Element (and each of the national applications) benefits from the performance results of the \$30M budget for Crosscutting Solutions (see Crosscutting Solutions Program Element Plan). The Energy Management Program Element leverages and extends research results from the approximately \$2.1B per year supporting Earth-Sun system science research and development of innovative aerospace science and technology.

Additional information about the NASA Applied Sciences Program can be found at <http://science.hq.nasa.gov/earth-sun/applications>.

** The National Applications and Crosscutting Solutions components of the Earth Science Applications Theme in the NASA FY05 Integrated Budget & Performance Document*

II. Goals and Objectives

The overall purpose of the Energy Management Program Element is:

To improve the Nation's public and private capability for integrating Earth-Sun system observations and predictions into sound management of energy demand and energy availability while expanding the economy and raising the standard of living of all Americans.

Towards this purpose, the Energy Management Program Element has the following goals:

1. Improve partner agencies' capabilities to utilize need-based specific global information from analysis of historic and recent NASA spacecraft observations and modeling predictions to enhance decisions and assessments concerning energy efficiency and energy production.

2. Improve partner agencies' capabilities to utilize need-based specific global information from predictive modeling spanning from short to long-term concerning energy efficiency and energy production.

The following objectives to be accomplished in FY05-FY09 support the Energy Management Program goals:

1. Release two upgraded versions (first release December 2004, second release February 2006) of the existing SSE website to include cloud and solar energy parameters at a true one degree latitude by one degree longitude resolution, high resolution meteorological data, new information from scientific research improving the data sets, and provide for the ability to use recently obtained and forecasted data in addition to historical data.
2. With a partner agency, tailor existing NASA observations to be compatible with existing industry design packages to allow building engineers and architects to include in their design space, the solar energy parameters needed to compute the ambient light resources of buildings areas for the purposes of increasing energy efficiency. Prototype dataset for industry evaluation purposes and requirements refinement to be released August 2005, with a benchmarked application in FY07. Perform evaluations in FY07 of additional opportunities with a partner agency and follow on with subsequent benchmarks to be completed in FY09.
3. With a partner agency, tailor existing NASA observations to be compatible with biomass production and management that supports Carbon Sequestration and Energy Production goals. Prototype dataset for industry evaluation purposes and requirements refinement to be released August 2008, with a benchmarked application in FY07. Perform evaluations in FY07 of additional opportunities with a partner agency and follow on with subsequent benchmarks to be completed in FY09.
4. Perform evaluation research of five energy sector related decision support systems or scenario assessment tools where NASA Earth-Sun system knowledge can be used to enhance policy or management decisions in the four Energy Management focus areas and identify NASA measurements and models for use in these tools. Candidates for evaluation research include the Edmonds-Reilly energy model, DICE Model, National Energy Modeling System, Electric Power Research Institute (EPRI) Neural Net Load Forecasting Tools, All Modular Industry Growth Assessment, Electric Power Research Institute SUNBURST Geomagnetically Induced Current tool, and International Energy Agency Renewable Energy Assessment Projects. At least two evaluations to be completed in FY05, four evaluations to be completed by first quarter FY06.
5. With a partner agency, tailor existing NASA data to be compatible with energy sector related decision support systems or scenario assessment tools where NASA Earth-Sun system science knowledge can be used to enhance policy or management decisions in the four Energy Management focus areas. Prototype dataset for evaluation purposes and requirements refinement to be released April 2006, with a benchmarked application in FY07. Perform evaluations in FY07 of additional opportunities with a partner agency and follow on with subsequent benchmarks to be completed in FY09. This effort includes activities directed toward predictive and load forecasting capabilities as well as Sun-Solar Research as it impacts the Energy production and security of national and international energy infrastructures.

6. Develop three partnerships with research and operations groups producing operation analysis and predictions to enable future use of Earth-Sun System knowledge. Candidate groups include EPRI, Department of Energy (DOE) Efficiency and Renewable Energy Program, DOE Information Agency, Joint Global Change Research Institute, and the Energy Modeling Forum at Stanford University. One partnership developed in each year of FY05-FY07.
7. Transfer at least 50% of benchmarked algorithms that are required to generate specific parameters to operational agencies by FY08.

The above objectives support the following items in the NASA Integrated Budget and Performance Document:

Objective 1.2 Expand and accelerate the realization of economic and societal benefits from Earth-Sun system science, information, and technology.

Outcome 1.2.1 By FY 2012, benchmark the assimilation of observations (geophysical parameters, climate data records) provided from twenty of the eighty remote sensing systems deployed on the flotilla of 18-22 NASA Earth observation research spacecraft.

Outcome 1.2.2 By FY 2012, benchmark the assimilation of five specific types of predictions resulting from Earth-Sun System Science Model Framework (ESMF) of twenty-two NASA Earth-Sun Division science models.

Objective 3.1 Enhance the Nation's security through partnerships with the Department of Defense (DOD), the Department of Homeland Security (DHS) and other U.S. or international government agencies.

Outcome 3.1.3 By FY 2012, in partnership with the DHS, the DOD and the Department of State, deliver fifteen observations and five model predictions for climate change, weather prediction and natural hazards to national and global organizations and decision-makers to evaluate five scenarios and optimize the use of Earth's resources (food, water, energy, etc.) for homeland security, environmental security and economic security.

III. Program Management and Partners

A. Program Management

The program management for the Energy Management Program Element resides in the Earth-Sun Systems Division. The Program Manager for this element is responsible for the following:

- Program Element development, strategy, plans and budgets
- Program representation, advocacy, and issues to Science Mission Directorate management and beyond.
- Communication of Applied Sciences priorities and directives to Energy Management Element team/network
- Implementation of interagency agreements and partnerships
- Monitoring Energy Management Program Element metrics and performance evaluation

Energy Management Element Program Manager:

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B. Partnerships

The Energy Management Element has active and developing partnerships aimed at providing observations from NASA missions and research projects directly to scenario assessment and decision support tools used in the energy sector.

Active Partnerships

Department of Energy, National Renewable Energy Lab
Point of Contact: Dr. David Renné

An agreement is in place between NASA and the Department of Energy's National Renewable Energy Laboratory (NREL) to support NREL's role in the development of energy related DSSs. This agreement includes the support of an improvement in the National Solar Radiation Database (NSRDB), which is vital for US exploration of solar renewable energy systems, and it allows for collaboration supporting NREL's work developing programs for energy efficient buildings and redistribution of energy (<http://www.nrel.gov/>).

Canadian Meteorological Service (CANMET) Energy Diversification Research Laboratory (CEDRL)
Point of Contact: Gregory J. Leng

The Energy Management Program Element is developing an agreement with the CANMET Energy Diversification Research Laboratory (CEDRL) to continue and expand current collaborations. CEDRL's renewable energy DSS called RETScreen is a package of macros used for the feasibility study of renewable energy projects that input solar energy, wind energy and geothermal energy systems. CEDRL and NASA have developed a direct link to the SSE website to provide environmental parameters which improve the cost benefit analysis of these projects to international and U.S. customers which includes investment agencies.

Developing Partnerships

Department of Energy (DOE) Energy Information Administration (EIA)
Collaboration with the Department of Energy Information Administration and the organizations that support the National Energy Modeling System (NEMS) will be critical to enhance the use of

NASA products in the NEMS modules such as the Renewable Fuels Module. Discussions with DOE EIA personnel are underway to forge this pathway.

Environmental Protection Agency (EPA) Office of Atmospheres Program

Negotiations and collaborations with the EPA personnel responsible for models, which impact energy production, are underway to forge pathways of predicted parameters for energy sector use.

National Oceanic and Atmospheric Administration (NOAA)

Negotiations and collaborations with the NOAA modeling to forge pathways of predicted parameters for energy sector use.

United States Department of Agriculture (USDA)

Partnerships with the USDA to support Energy Production scenario assessments using biomass are targeted through an existing agreement with the USDA and NASA.

Electric Power Research Institute (EPRI)

Negotiations are ongoing to forge a partnership between the EPRI and NASA to support EPRI's load forecasting DSS. EPRI has developed a short-term load forecasting DSS for utilities. EPRI is interested in improving this DSS and in developing longer term forecasting tools.

Other organizations such as the Western Governors Association (WGA), Aerospace States Association (ASA), American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) and the American Institute of Architects (AIA) present additional partnership opportunities.

The Energy Management Program Element performs evaluation research in the areas of energy production, energy efficiency, measuring and monitoring of greenhouse and other gases, and carbon sequestration as related to the energy sector, to develop new partnerships through the program element activities described below.

IV. Decision Support Tools

The following are decision support tools that investigators funded through the Program currently or plan to work with, pending successful partnership negotiations.

RETScreen

RETScreen is a decision support tool developed by the Canadian Meteorological Service (CANMET) Energy Diversification Research Laboratory (CEDRL) with the contribution of numerous experts from government, industry, and academia. The software is a package of macros used for the feasibility study of renewable energy technologies (RETs) that impact solar energy, wind energy, and geothermal energy systems. CEDRL and NASA have developed a direct link to the SSE website to provide environmental parameters which improve the cost benefit analysis of these projects to international customers using RETScreen.

<http://www.etscreen.net/ang/menu.php>

HOMER

HOMER is a computer model that simplifies the task of evaluating design options for both off-grid and grid-connected power systems for remote, stand-alone, and distributed generation applications. HOMER is developed by the Department of Energy National Renewable Energy Laboratory (NREL). An agreement is in place between NASA and NREL to support the improvement of the National Solar Radiation Database (NSRDB), which is significant for US exploration of solar renewable energy systems. <http://www.nrel.gov/homer>

Solar Sizer

Solar Sizer, developed by the Center for Renewable Energy and Sustainable Technology (CREST) and Solar Energy International, is a tool for the design of residential photovoltaic systems. <http://www.crest.org>

EPRI Neural Net Load Forecast Tool

The Electric Power Research Institute (EPRI) has developed a short-term (1-7 day) load forecasting decision support tool for the utility industry. EPRI is interested in improving this tool and in the development of longer term forecasting tools. Negotiations are ongoing to forge a partnership between EPRI and NASA to support these load forecasting tools by infusing observations derived from NASA observational spacecraft products. <http://www.epri.com>

V. Application Activities

Program Element projects and activities form networks to establish the interactions with the scientific research and modeling community, which is essential, to improve the DST in the energy related sector. The Program Element projects provide for the integration and assimilation of NASA Earth-Sun System Science observation and model prediction research results to meet the needs of the partner and also provides for benchmarking of the resulting outputs of the partner's DST.

A. Projects

Competitive Peer Reviewed Projects and Activities

The Energy Management Program Element enhances the management, relevance, effectiveness, and productivity of core element projects and activities using peer review. A critical, formal and documented evaluation process using objective criteria and qualified and independent reviewers to make a judgment of the technical/ scientific/business merit, the actual or anticipated results, and the productivity and management effectiveness of projects ensures the highest potential for effective outcomes and socioeconomic impacts from these competitive activities. The following activities are subject to peer review.

Project : POWER (Six subprojects) Focus Area: Energy Production, Energy Efficiency				Procurement Budget \$K	
<p>The goal of this project is to evaluate, validate and benchmark Earth science products, observational spacecraft measurements, and assimilation products, for beneficial, routine use in Energy Sector DSS. Five subprojects exist under the POWER Project. The activities and FY05 funding levels are listed below:</p> <p>Activities-</p> <p>Energy Production Solar Incidence Products Validate Earth-Sun System science and solar incidence products for use by RETScreen, and HOMER (1) Complete processing for 18+ years of industry parameters using GEOS 4.0.3 (2) Complete validation for parameters (3) Upgrade SSE web site with new 18+ year dataset (SSE Rel. 5,5)</p> <p>Energy Production NSRDB Validate and benchmark Earth-Sun system products with NREL's NSRDB fulfilling Memorandum of Understanding (MOU) obligations. Support FY06 benchmark (1) Interact and provide validation data for NREL/NSRDB (2) Complete 10+ year dataset for NSRDB project to span critical 90's decade (3) Deliver data</p> <p>Energy Efficiency Environment Building Design V&V and benchmark products for environmental building design with partner NREL and pursue ASHRAE and DOE Housing follow on from rapid prototype demonstration. Potential for benchmark > FY06 (1) Working with partner improve and deliver buildings dataset. (2) Develop new interface for data access via web (3) Pre-release building data on web site</p> <p>Energy Production/Efficiency Short-term/Mid-term prototype development. (1) Develop methodology to produce industry parameters from forecasts of GOCART/RAQMS Air Quality forecast model for limited regions (2) Obtain information regarding data parameters needed for EPRI ANNMTLF prototype (3) Select test periods and obtain sample data sets from NOAA/NSIPPcollaborating researchers (4) Begin methodology study to produce seasonal forecast (5) Assess quality</p> <p>Energy Efficiency Energy Load Forecasting Evaluate, V&V, and benchmark products for energy load forecasting (NREL/EPRI) (1) Using specifications from Evaluation Report in FY05, develop methodology to produce industry parameters from forecasts of GOCART/RAQMS Air Quality forecast model for limited regions. (2) Assess quality</p> <p>Energy Production Biomass Products Evaluate, V&V, and benchmark products for biomass production. Following FY05 Evaluation Report, prototype global set. (1) Derive parameter list for biomass/agricultural planning needs (2) Develop prototype and deliver to customer from 5-year GEOS 4.0.3 dataset with precipitation from the GPCP</p> <p>In addition to projects listed above, this effort includes funding in FY08-09 to support the core knowledge capability required to ensure consistent developments in future energy project applications.</p>				FY05 530	
<i>Project Manager</i>	<i>Implementing Orgs</i>	<i>Timeframe</i>	<i>Partners</i>	FY06	470
Dr. Paul Stackhouse-LaRC	NASA LaRC, NASA GSFC, NASA SSC, NASA MSFC	FY05-FY09	DOE NREL, EPRI	FY07	460
				FY08	350
				FY09	345
<i>Deliverables</i>	Evaluation report, contact network, agreement/joint development plan, benchmark reports, results conferences			<i>Other Apps.</i>	
<i>Element Objectives Supported</i>	Objectives 1, 2, 3, 4, 5, 6			Air Quality, Agricultural Efficiency	

Project: International Energy Agency (IEA) (Task 36 Solar Resource Knowledge Management)					
Focus Area: Energy Production					
<p>NASA will participate in the IEA task and support the objectives of the task listed below. This work is performed under the MOU with NREL and will use NASA datasets and expertise to add value to the standardization and structure of the products that will serve multiple countries.</p> <p>The objective of Task 36 is to provide further standardization, better data reliability and availability, and improved spatial and temporal coverage, with customized solar resource products, including reliable solar radiation forecasts, which are easily accessible to industry. Achieving these objectives would reduce the cost of planning and deploying solar energy systems, improve efficiency of solar energy systems by more accurate and complete solar resource information, and increase the value of the solar energy produced by solar systems. This objective will be met by accomplishing three subtasks:</p> <p>a) Standardization of solar resource products to insure worldwide interoperability and acceptance;</p> <p>b) Development of a common structure for archiving, processing and accessing solar resource information, such as through a single portal;</p> <p>c) Improved techniques for solar resource characterization and forecasting</p> <p>An official IEA task represents acceptance of a proposal by an Executive Committee within the International Energy Agency. The proposal requires a collaboration of at least seven countries that are members of the IEA. Proposed tasks are five years in duration. Performance will be measured through IEA technical reports and through the development of solar energy data set portals. The technical reports will measure the value of NASA data and research toward estimating solar fluxes at the Earth’s surface, identifying requirements for improvements and predictions, and developing standards for data distribution. These objectives will represent a NASA contribution to GEOSS objectives for solar irradiance, a parameter identified as key for both Energy Resource Management and Climate outcome themes.</p> <p>End-users include the solar energy industry, designers, and architects of renewable energy systems. As renewable use in power plants and buildings grows the data will be required in larger sectors of the energy industries including the generating utilities.</p>				Procurement Budget \$K	
				FY05 70	
Project Manager	Implementing Org	Timeframe	Partners	FY06	130
Dr. Paul Stackhouse-LaRC Partner Project Manager Dr. David Renne - NREL	LaRC, NREL	FY05-FY09	DOE	FY07	140
				FY08	150
				FY09	155
Deliverables		Evaluation report, contact network, agreement/joint development plan, results conference			Other Apps.
Element Objectives Supported		Objectives 4, 5, 6			

Project: Energy Management Policy Models (2 subprojects)				
Focus Area: Energy Production, Energy Efficiency				
<p>The goal of this activity is to evaluate, validate and benchmark Earth-Sun System science products, spacecraft measurements, and assimilation products, for beneficial, routine use in Energy Sector scenario assessments that support management and policy decisions. The activities and FY05 funding levels are listed below:</p> <p>Energy Policy Models Evaluations: (FY05 funding level \$65K) Support NASA scenario assessment participation through DOE, EPA and other agencies. Future V&V and benchmark projects will follow from this work.</p> <p>NEMS Evaluation: (FY05 funding level \$25K) DOE expressed interest in NASA data to support policy assessments, follow through to workshop</p> <p>Future funding levels for these two projects will depend on the outcome of the evaluation and rapid prototyping. Future funding may be applied to additional evaluations of similar policy tools. The work following the evaluation period in FY05 and FY06 will likely be submitted for continuation under an Agency open solicitation. FY07-FY09 Funding levels reflect expected effort for budget purposes and solicitation planning.</p>				<i>Procurement Budget \$K</i> FY05 90
<i>PS Manager</i>	<i>Implementing Orgs</i>	<i>Timeframe</i>	<i>Partners</i>	FY06 75
R. Eckman - LaRC	HQ, Centers	FY05-FY09	DOE	FY07 75
				FY08 75
				FY09 75
<i>Deliverables</i>	Evaluation report, contact network, agreement/joint development plan, results conferences			<i>Other Apps.</i>
<i>Element Objectives Supported</i>	Objectives 3, 4			N / A

Program Study: GEOSS, IWGEO, CCSP, CCTP Decision Tools Evaluation				
<p>This study identifies the scenario assessments and decisions facing the organizations responsible for international and national policy as it concerns the GEOSS, and the Administration's IWGEO, CCSP, and CCTP. It will examine scenario assessment tools that impact policies as well as management decisions and the potential role Earth-Sun System science results may play in the policy-making and decision support. This activity provides a framework to transfer benchmarked NASA observations and predictions in the Energy related activities of GEOSS, IWGEO, CCSP, and CCTP.</p>				<i>Procurement Budget \$K</i> FY05 35
<i>PS Manager</i>	<i>Implementing Orgs</i>	<i>Timeframe</i>	<i>Partners</i>	FY06 50
R. Eckman - LaRC	HQ, LaRC, GSFC, SSC	FY05-09	DOE Pacific Northwest National Lab, SAIC	FY07 50
				FY08 50
				FY09 50
<i>Deliverables</i>	Evaluation report, contact network, agreement/joint development plan, benchmark reports, results conferences			<i>Other Apps.</i>
<i>Element Objectives Supported</i>	Objectives 3, 4			N / A

Project : Energy Management Future Projects									
Focus Area: Energy Production, Energy Efficiency									
<p>The goal of this future project is to evaluate, validate and benchmark Earth-Sun System science products, spacecraft measurements, and assimilation products, for beneficial, routine use in Energy Sector DSS. Subprojects or projects will be created based on the future work. The focus areas include:</p> <p>Energy Efficient Environment Building Design: Based on evaluations to be completed in FY07, V&V and benchmark products for environmental building design with partner agencies such as NREL. Provide a benchmarked application of NASA data in FY09.</p> <p>Energy Efficiency Energy Load Forecasting Based on evaluations to be completed in FY07, V&V and benchmark products for environmental building design with partner agencies such as NREL. Provide a benchmarked application of NASA data in FY09.</p> <p>Energy Production Biomass Products Based on evaluations to be completed in FY07, V&V and benchmark products for biomass production with partner agencies such as USDA. Provide a benchmarked application of NASA data in FY09.</p> <p>Future funding levels for these projects will depend on the outcome of the evaluation. and rapid prototyping. Future funding may be applied to additional evaluations of similar policy tools. The work following the evaluation period in FY07 will likely be submitted for continuation under an Agency open solicitation. FY08-09 funding levels reflect expected effort for budget purposes and solicitation planning.</p>				<i>Procurement Budget \$K</i>					
				FY05	0				
				<i>Project Manager</i>	<i>Implementing Orgs</i>	<i>Timeframe</i>	<i>Partners</i>	FY06	0
				R. Eckman - LaRC	HQ, Centers	FY07-09	DOE, UDSA	FY07	50
FY08	100								
FY09	100								
<i>Deliverables</i>		Evaluation report, contact network, agreement/joint development plan, benchmark reports, results conferences		<i>Other Apps.</i>					
<i>Element Objectives Supported</i>		Objectives 1, 2, 3, 4, 5, 6		Air Quality					

B. Solicitations

The Energy Management Program Element plans to solicit projects through competitive announcements starting in FY05 through the Applied Sciences Program “Decisions” solicitation. The Energy Management Program Element coordinates priorities with its partners and plans to pursue the release of a jointly funded solicitation with agencies participating in the CCSP and CCTP. The Element leverages appropriate activities, expertise, and assets selected through other Science Mission Directorate solicitations announcements that serve the Element’s objectives; the Energy Management Program Element may provide supplemental funding to develop or target specific activities in a proposal

C. Congressionally Directed Activities

The program element team interacts with the fund recipients to align the activities with the goals and objectives of the Applied Sciences Program.

There are no congressionally directed activities related to the Energy Management program element in FY05.

D. Program Management

The Energy Management Program Element authorizes activities that contribute to the overall success of the Element through studies, working group participation, program reviews, and other endeavors.

Program Management: Decision Support Tools, Partner Plans, Working Groups, Committees				
Identify and evaluate Energy management issues and decision support tools for future support Examine and analyze Energy plans and strategies of existing and potential partner organizations Support interagency, national, regional, and international working groups (e.g. IGOS) Identify areas where NASA Space Weather can contribute to management decision systems Maintain Core Capability in discipline domain				Procurement Budget \$K
				FY05 50
PM Managers	Implementing Orgs	Timeframe	Partners	FY06 50
Paul Stackhouse – LaRC Shahid Habib-GSFC T. Frisbie – SSC R. Eckman - HQ	HQ, LaRC, GSFC, SSC	Annual	-	FY07 50
				FY08 50
				FY09 50
Deliverables	Evaluation report, contact network, agreement/joint development plan, benchmark reports, results conferences, identification of Earth-Sun science products			Other Apps.
Element Objectives Supported	Objectives 1, 2, 3, 4, 5, 6			N / A

Element Projects have a project manager who is responsible for the following:

- Leadership on project plans, development, performance, and partnership relationships
- Communication of project metrics, performance, status, and issues to Program Manager
- Leadership and communication to Energy Management Program Element team and network
- Management for assigned tasks, grants and cooperative agreements

The respective Project Managers are responsible for developing project plans and managing the activities to support the element, NASA's Earth-Sun System Division, and its partners.

Manager for POWER and International Energy Agency Projects:

Dr. Paul Stackhouse

Paul.W.Stackhouse@nasa.gov

Manager for Energy Management Policy Models Project:

Dr. Richard Eckman

Richard.S.Eckman@nasa.gov

E. Additional Activities and Linkages

The Crosscutting Solutions Program—The program consists of functional elements that contribute to all of the National Applications activities. The intention is to have the performance of these functions leverage accomplishments, and therefore the apparent resource investment, to the greatest extent possible into the National Applications partnerships. These functions are: Geoscience Standards and Interoperability, Human Capital Development, Integrated Benchmark Systems, and Solutions Networks. Examples of leveraged activities are:

- *The Earth-Sun System Gateway* is a “portal of portals” providing an access point through an Internet interface to all web-enabled NASA research results.
- *A Rapid Prototyping Center* is a proposed center at Stennis to support NASA and partners in testing and verification of Earth science results in decision support tools
- *Transition from Research to Operations Network (R2O)* is a network that focuses on systematically transitioning the results of research to operational uses.
- *DEVELOP* is a student-based program for rapidly prototyping solutions for state and local applications and helping students develop capabilities related to applied Earth-Sun science.

NASA and Science Mission Directorate Priorities

- *Federal Enterprise Architecture (FEA)* is a business and performance-based framework to support cross-agency collaboration, transformation, and government-wide improvement.
- *The Global Information Grid (GIG)* is the first stage of a U.S. military global, high-bandwidth, Internet protocol-based communications network (a.k.a., ‘the Internet in space’).
- *The Joint Center for Satellite Data Assimilation (JCSDA)* is a multi-agency collaboration to accelerate and improve the quantitative use of research and operational observational spacecraft data in weather and climate prediction models. NOAA (NESDIS, NWS, OAR), NASA, Navy, Air Force, and NSF (through UCAR) collaborate in JCSDA.
- *Metis* is a visual modeling software tool for planning, developing, and analyzing agencies' enterprise architectures. The Applied Sciences Program is using Metis to identify possible linkages between observations, models, and decision support tools to support the IWGEO and NASA/NOAA R2O activities.
- *Observing System Simulation Experiments (OSSEs)* use simulated observations to assess the impacts of future observational spacecraft instruments on weather and climate

prediction and provide opportunities to test new designs and methodologies for data gathering and assimilation.

- *Project Columbia* is a NASA-wide project to develop a new, fast supercomputer (using an integrated cluster of interconnected processor systems) to support the Agency's mission and science goals, including enhanced predictions of weather, climate, and natural hazards.

Cross-Application Activities

The Energy Management Team coordinates and evaluates activities jointly with other National Applications on related topics and decision support tools. Related topics include:

Connection with Agricultural Efficiency: Biomass products for energy production

Connection with Carbon Management: Carbon Sequestration as related to the Energy Sector

Additionally, the Energy Management Element draws on capabilities and services supported and funded through other components of the Applied Sciences Program that include Integrated Benchmark Solutions Systems Engineering Support.

Applied Sciences Research and Education Activities

The Energy Management Element draws on research activities supported by the Earth-Sun System Science Research community and the Earth-Sun System Science Education programs that may have potential or specific applications to the element's goals and objectives. The Energy Management Element monitors the activities to leverage the results and outputs. The current activities applicable to the Energy Management Element are listed in Appendix C.

Element Networks

In addition to the networks formed by the projects, the Energy Management Program Element leadership draws upon an extensive network as it performs the evaluation research activities prior to forming partnerships to enhance a partner's Decision Support Tool. Portions of the NASA network include:

Science Mission Directorate and NASA Centers:

Atmospheric Composition Theme	Phil DeCola, NASA HQ
Climate Change and Variability Theme.....	Waleed Abdalati, NASA HQ
Weather Theme.....	Jim Dodge, NASA HQ
Tropospheric Chemistry.....	Jim Gleason, NASA HQ
Tropospheric Aerosols, Radiation Sciences	Don Anderson, NASA HQ
Technology	Gran Paules, NASA HQ
Business and Budget	Tanye Coleman, NASA HQ

Goddard Space Flight Center (GSFC)	Shahid Habib
Langley Research Center (LaRC)	Paul Stackhouse
Marshall Space Flight Center (MSFC)	Dale Quattrochi
Stennis Space Center (SSC)	Troy Frisbie

VI. Budget: Fiscal Year 2005

The following table lists the Energy Management Program budget (procurement) for FY2005:

Energy Management	
Project	FY05 Procurement Allocation (\$K)
Energy Production: V&V Earth science and solar incidence products (SSE Rel 5.5) RETScreen, HOMER	\$110
Energy Production: V&V Earth science products with NREL NSRB	\$100
Energy Efficiency: Eval. And V&V products for environmental building design	\$100
Energy Production/Efficiency: Short-term/Mid-term Prototype Development	\$70
Energy Efficiency: Eval. And V&V products for biomass	\$75
Energy Efficiency: Eval and prototype Electric Power Load Forecast	\$75
Energy Production International Energy Agency task	\$70
Energy Production/Efficiency: Policy Assessments Evaluation, Rapid Prototype	\$50
Energy Production: NEMS Eval, Rapid Prototype Dataset	\$40
Program Study: GEOSS, IWGEO, GEO, CCSP, CCTP Impact Assessment	\$35
Program Management: National Energy Decision Tools, Evaluation, Workshops	\$50
Total	\$775

Appendix C lists program-wide budget allocations for FY2005.

VII. Schedule and Milestones

From the roadmap, specific milestones, expected in the next five years, are derived to support Element goals and objectives. These milestones are listed in Table 1.

Table 1. Energy Management Element milestones for FY05-09

Milestones	FY05	FY06	FY07	FY08	FY09
SSE Release 5	Dec-04				
SSE Release 6		Feb-06			
Complete data delivery for NSRDB.	Aug-05				
Evaluation Research (reports complete)					
ES Obs./Predictions for Energy Production using Biomass	Jun-05		Jun-07		
ES Obs./Predictions for Energy Efficiency in Buildings	Jun-05		Jun-07		
ES Obs./Predictions for Energy Production load forecasting	Aug-05		Jun-07		
ES Obs./Predictions for Energy Production/Efficiency impacts to Policy and Scenario Assessments	Jun-05		May-07		May-09
Prototype Datasets (delivered)					
Energy Efficient Building Prototype	Aug-05				
Renewable Energy NSRDB Prototype	Jun-05				
Electric Power Load forecast prototype		Jul-06			
Agricultural Prototype Dataset	Jul-05				
Targeted Prototypes for Energy Production/Efficiency		Jan 06		Jul-08	Jun-09
Benchmark Reports (dependent on Evaluation Results)					
SMD Results for Energy Production/Efficiency		Jan-06	Jul-07	Jul-08	Jul 09
Partnerships with Operational Organizations					
Energy Production/Efficiency	Jan-05		Jan-07		Jan-09
Greenhouse Gas Meas. And Monitoring		Jun-06			
Predictive Capabilities	Jul-05		Jun-07		

VIII. Program Element Performance Measures

The Energy Management Element uses performance measures to track progress, identify issues, evaluate progress, make adjustments, and establish results of the program element. The management team analyzes these measures in order to make adjustments to the program approach and objectives in order to achieve element goals. The measures are in two categories:

- 1) Program Management measures are internally focused to assess the process and associated activities, shown in Figure 4, that implement an integrated systems solution within the element.
- 2) Performance measures are externally focused to assess if the program activities are serving their intended purpose of impacting the outcomes of partner's decision support tools and ultimately the impact on society.

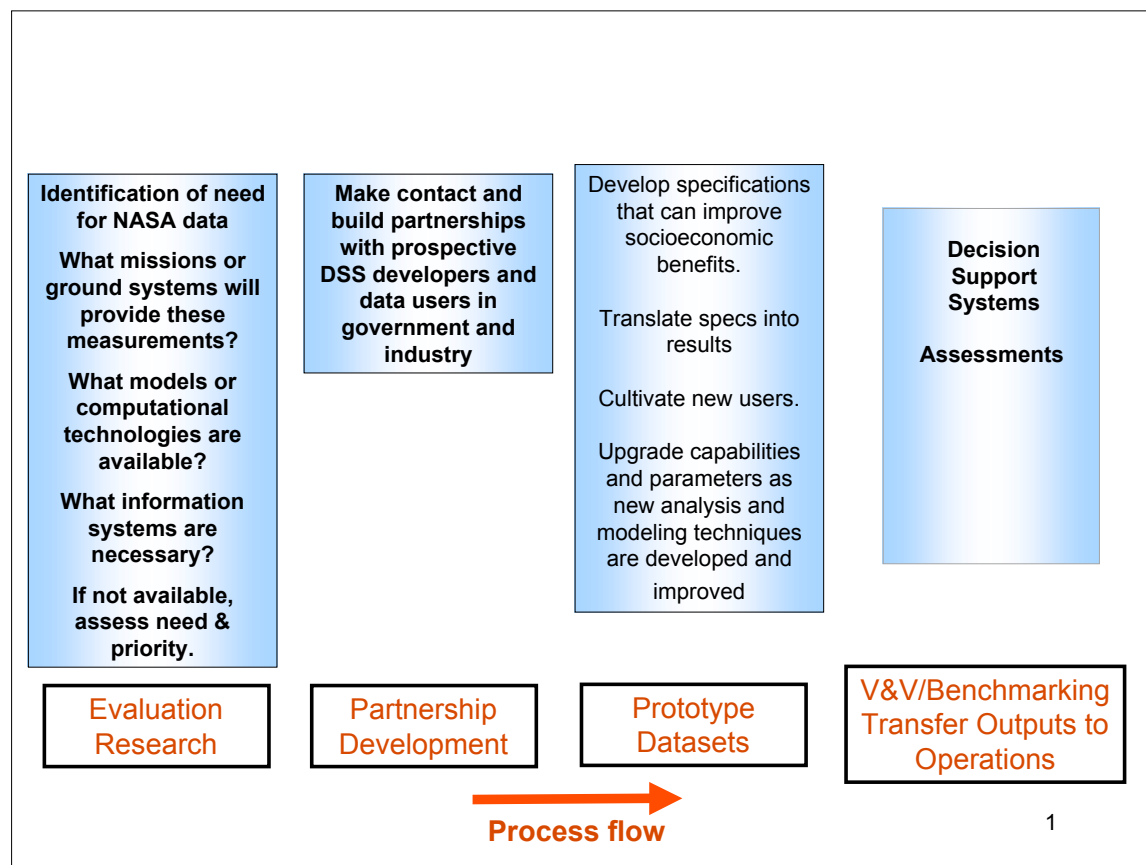


Figure 4. Energy Management Implementation Approach Process Flow and Example Activities

Table 3 provides the metrics and the types of measures used to assess the Energy Management Element. In addition, the Earth-Sun System Division uses this information in preparing IBPD directions and PART responses

Table 3. Program and Performance Measures for Energy Management

Program Management Measures (Internal):

Integrated System Solution Process Implementation Metrics	<p><u>Metric 1:</u> Assessments or evaluations of potential issues and DSTs identified for Energy Management –</p> <p><u>Measure 1:</u> number, type, range</p> <p><u>Metric 2:</u> Assessments of Earth science results/products to serve DSTs</p> <p><u>Measure 2:</u> number, type, range</p> <p><u>Metric 3:</u> Potential results/products identified to serve Energy Management</p> <p><u>Measure 3:</u> number, type, range</p> <p><u>Metric 4:</u> Partner participation in integrated system solution</p> <p><u>Measure 4:</u> number of formal agreements, number of leveraged activities, value of resources contributed by partner</p> <p><u>Metric 5:</u> Activities developing prototype datasets</p> <p><u>Measure 5:</u> number, type, range</p> <p><u>Metric 6:</u> Activities transferring datasets to operational use</p> <p><u>Measure 6:</u> number, type, range</p> <p><u>Metric 7:</u> Evaluation, validation, benchmark reports</p> <p><u>Measure 7:</u> number, type</p>
Quality and Efficiency	<p><u>Metric 1:</u> Reports</p> <p><u>Measure 1:</u> partner satisfaction, timeliness, time to develop</p> <p><u>Metric 2:</u> Reports</p> <p><u>Measure 2:</u> ratio of validations to potential products, ratio of benchmarks to validations</p> <p><u>Metric 3:</u> Agreements</p> <p><u>Measure 3:</u> ratio of formal agreements to committed partners</p> <p><u>Metric 4:</u> Element relevance to sector</p> <p><u>Measure 4:</u> number of invitations by partners or others to participate or support similar activities</p> <p><u>Metric 5:</u> Process efficiency</p> <p><u>Measure 5:</u> time to transfer to operations from completion of benchmark, time to complete each process phase</p>

Performance and Results Measures (External):

Outcomes	<p><u>Metric 1:</u> Earth-Sun System science products in use in partner DSTs</p> <p><u>Measure 1:</u> number, type, range; use in DST over time</p> <p><u>Metric 2:</u> Partner and DST performance</p> <p><u>Measure 2:</u> change in partner DST performance, number and type of public recognition of use and value of Earth-Sun Systems science data in DST</p>
Impacts	<p><u>Metric 1:</u> Socioeconomic impact/partner value</p> <p><u>Measure 1:</u> change in partner metrics (improvements in value of partner decisions)</p>

In addition to the stated measures, the Energy Management Element periodically requests an assessment of its plans, goals, priorities, and activities through external review. The Energy Management Element team uses these measures along with comparisons to programmatic benchmarks to support assessments of the Earth Science Applications Program (e.g. internal NASA reviews and OMB PART). The Energy Management Program Element uses comparisons to similar activities in the following programs (i.e. program benchmarks) to evaluate its progress and achievements:

- Environmental and Societal Impacts Group at NCAR
- Global Monitoring for Environment and Security (GMES)

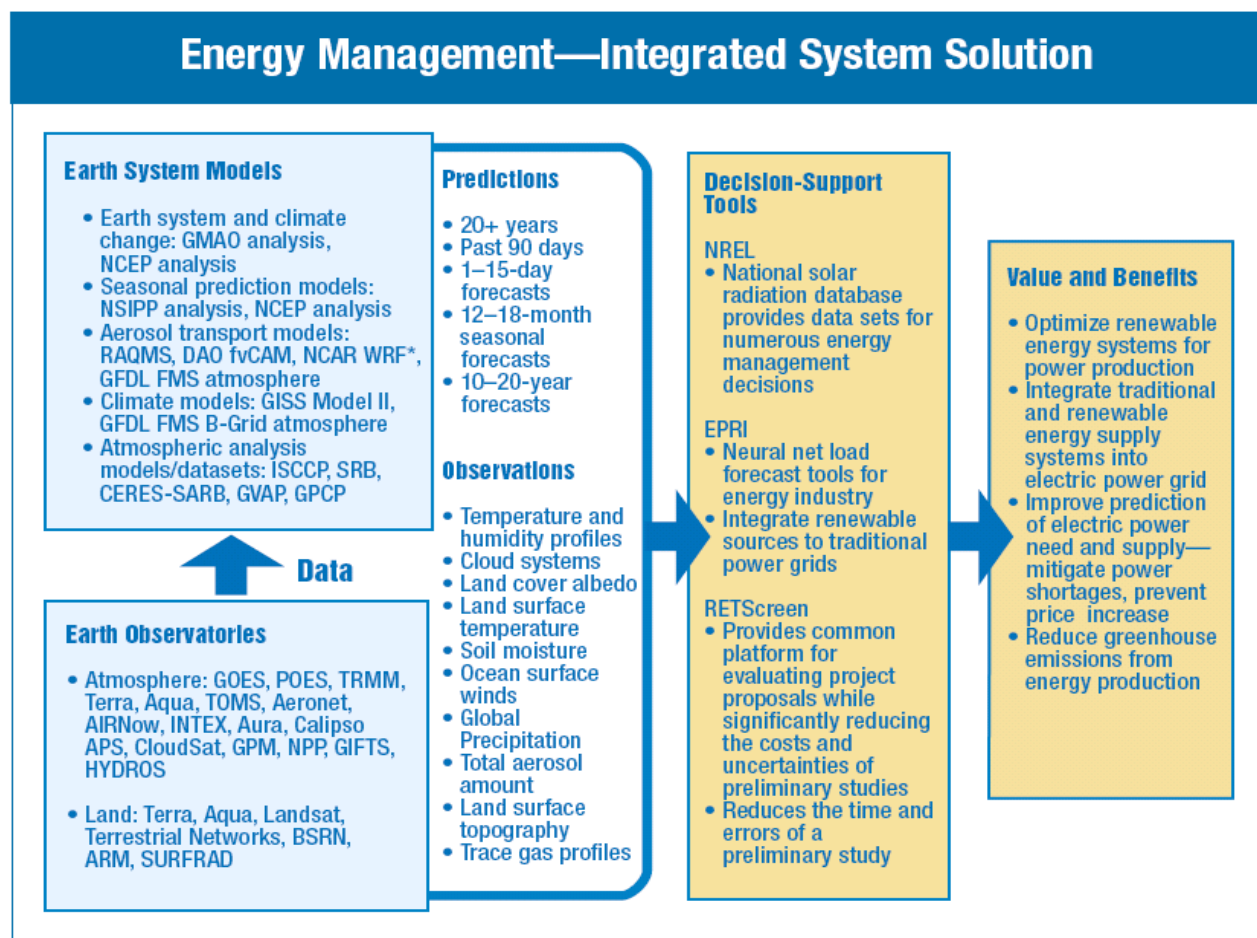
IX. Appendices

Appendix A. Integrated System Solution

The Energy Management Element accomplishes its goals and objectives by implementing an integrated system solutions approach as shown in Figure 1.

In this approach, NASA forms partnerships with organizations responsible for implementing decision support tools that effect policy and management decisions in the Energy Management sector. The integration of NASA observations and model predictions with the partner's decision support tools is enabled through element projects and activities. In support of the Administration priorities, this approach facilitates the transition from research to operations that is a critical element in all the Administration initiatives.

For FY05-09, the Energy Management Program Element focuses efforts on the development of partnerships and implementation of projects that enable the integrated systems solutions shown below.



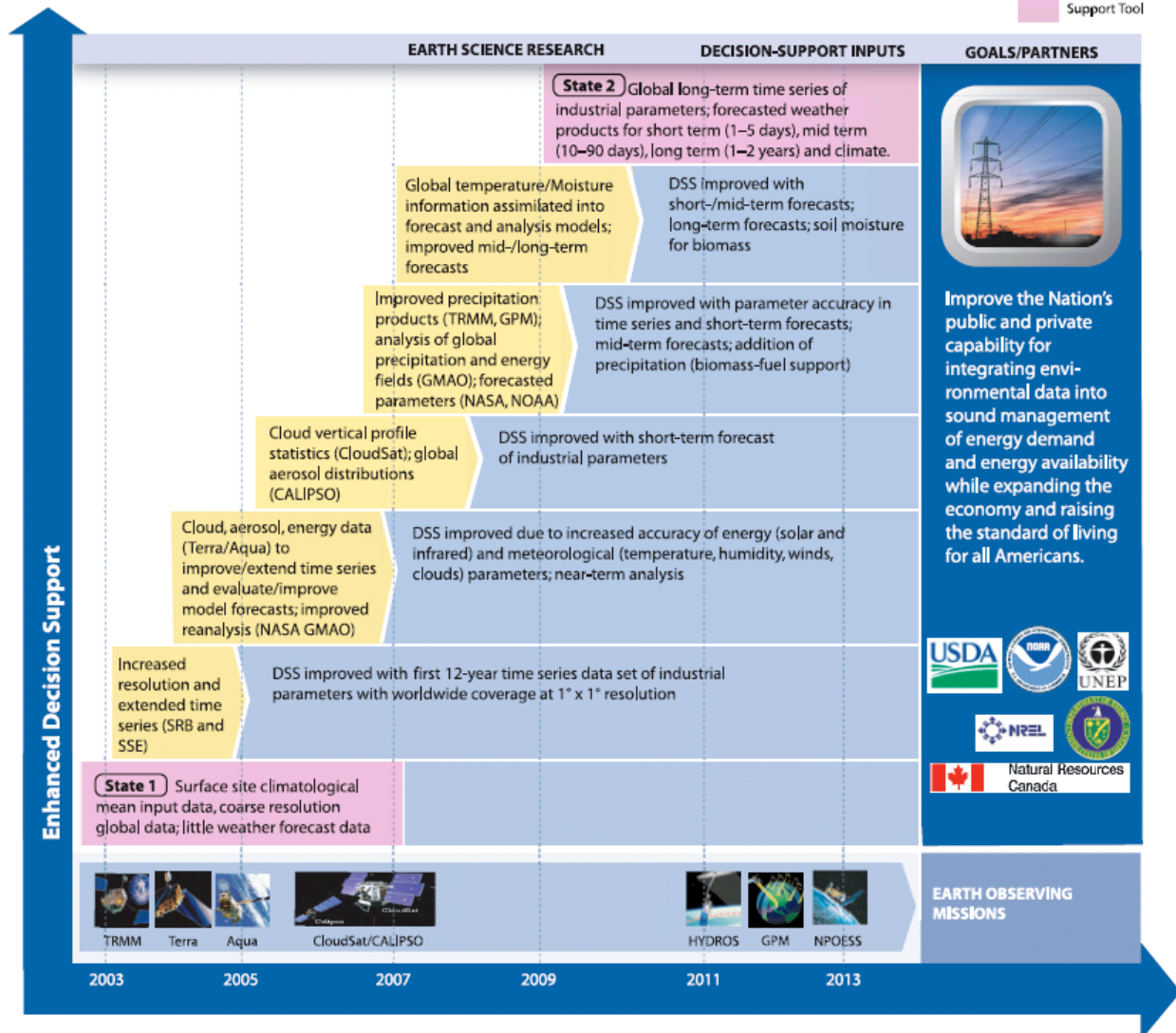
Appendix B. Roadmap

The Energy Management Element goals and objectives are derived from the progressive nature of the link between the increasing capabilities and supportive information needs of the Energy sector's decision support tools and scenario assessments, and the increased capabilities of NASA supported observational spacecraft observations and model predictions and the resulting Earth science research results. The progressive nature of the link is depicted in the roadmap shown in this appendix. The roadmap was developed considering the present state in the energy sector in which policy and energy management decisions are based primarily on the use of historical climatic information and traditional weather data reports, consisting of air temperature, precipitation, humidity, and wind measurements. It was also recognized at present there is limited to no use of spacecraft observations and global model predictions in the energy production and energy efficiency decisions that impact society. Ultimately, as depicted in the roadmap, the future state will evolve to the point where partner agencies support the operational use of satellite-based, global real-time and forecasted weather and climate datasets, parameterized for the energy sector, in the decision systems used by energy management planners and the scenario assessment models used by policy makers. The roadmap graphically depicts the strategy to initially emphasize historical datasets and the development of new prototypes to expand applicability with near-real time and forecasted datasets being phased in as better validation mechanisms are developed with the partners. Also phased with time are new industry sectors such as the biomass industry sector which is delayed until 2006 when better precipitation datasets are expected from both spacecraft and modeling systems. The roadmap portrays a steady progression and depicts a long-term plan as in some instances impacts are not seen for several years, such as the case with the electric power industry datasets that take the longest to be effective due to the expected developed of electric power redistributions systems.

Roadmap

Energy Management

Unfunded
Funded
Decision-Support Tool



Appendix C. Applied Sciences Program Budget FY2005

The overall program budget allocations are given below to provide the context in which this National Application is conducted. The allocations are based on Agency and program priorities and are subject to change according to the availability of funds and programmatic strategies. All values are in \$ thousands.

*NOTE: Allocations include full utilization of the Applied Sciences FY04 carryover of approximately \$2.7 million.

Table 1: Applied Sciences Procurement Allocation – FY05

Program Element	FY05 Procurement Allocation
National Applications	
Agricultural Efficiency	\$ 467
Air Quality Management	\$ 995
Aviation	\$ 750
Carbon Management	\$ 653
Coastal Management	\$ 550
Disaster Management	\$ 545
SENH	\$ 1,429
Ecological Forecasting	\$ 610
Energy Management	\$ 775
Homeland Security	\$ 205
Invasive Species	\$ 205
Public Health	\$ 725
Water Management	\$ 870
Program Director Discretionary Fund	\$ 588
Center Director Discretionary Fund Tax	\$ 2,485
National Applications Total	\$ 11,852
Crosscutting Solutions	
Integrated Benchmarked Systems	\$ 3,529
Solutions Networks	\$ 1,200
Competitive Solicitations	\$ 7,600
Human Capital Development	\$ 700
Geoscience Standards & Interoperability	\$ 2,000
Crosscutting Solutions Total	\$ 15,029
Applied Sciences Program Procurement Total	\$ 26,881

Table 2: Applied Sciences Program NASA Institutional Allocations – FY05

NASA Center	FY05 Institutional Cost / National Applications	FY05 Institutional Cost / Crosscutting Solutions	Institutional Total
HQ	\$3,773	\$7,351	\$11,124
ARC	\$1,108		\$1,108
GSFC	\$1,009	\$1,094	\$2,103
JPL			
LaRC	\$1,517	\$444	\$1,961
MSFC	\$1,251	\$183	\$1,434
SSC	\$3,194	\$8,689	\$11,883
Total	\$11,852	\$17,761	\$29,613

Appendix D. Related NASA and Partner Solicitations and Grants

Activities funded by the Science Mission Directorate, which are producing results that, upon completion, may have direct applicability to the Energy Management Element are listed below.

NRA-02-OES-06 “Investigations That Contribute To The NASA Earth Science Enterprise's Multidisciplinary Research In Climate, Chemistry, And Global Modeling”

Carlson, Barbara NASA Goddard Institute for Space Studies
Investigation of Satellite Observations of Climate Variability

Chin, Mian NASA Goddard Space Flight Center
Global and Regional Aerosol Modeling Study: Sources, Distributions, and Near-term to Long-Term Climate Effects

Chuang, Catherine Lawrence Livermore National Laboratory
Radiative Impacts of Aerosols and Greenhouse Gases on Climate: Studies with the Integrated Chemistry-Aerosol Model and High Resolution Climate Model

Hansen, James Goddard Institute for Space Studies
Climate Forcings and Response on Satellite and Century Time Scales

Hou, Arthur NASA Goddard Space Flight Center
Cloud-Radiation Precipitation Modeling and Assimilation for Improving Weather Prediction and Climate Modeling

Kaufman, Yoram NASA Goddard Space Flight Center
IDS Proposal: The Global Aerosol System and Its Direct and Indirect Forcing of Climate

Mishchenko, Michael NASA Goddard Institute for Space Studies
Long Term Global Aerosol Climatology Based on Analyses of Multi Channel Satellite Radiance Data

Penner, Joyce University of Michigan Ann Arbor
Support of the UNFCCC Secretariat's Study of the Brazil Proposal

Stackhouse, Paul NASA Langley Research Center
The NASA/GEWEX Surface Radiation Budget

Xu, Kuan-Man NASA Langley Research Center
Large Ensemble Evaluation of Cloud Models and Super Parameterization Using EOS Satellite Cloud, Radiation and Precipitation Data

NRA 03-OES-02 “Earth System Science Research Using Data And Products From Terra, Aqua, And Acrim Satellites”

Adler, Robert Goddard Space Flight Center

Use of AQUA Information in Global Multi-Satellite Precipitation Analysis

Barker, Dale National Center for Atmospheric Research

The Impact of EOS Satellite Data Assimilation on Weather Analysis and Prediction at High Southern Latitudes

Baum, Bryan Cooperative Institute for Meteorological Satellite Studies

Regional And Global Analyses Of Multilayered Clouds, Ice-Phase Clouds And Mixed-Phase Clouds Using Eos Terra And Aqua Data

Bosilovich, Michael Goddard Space Flight Center (GMAO)

The Impact of EOS Surface Temperature on Global Reanalysis

Carlson, Barbara Goddard Institute for Space Studies

Understanding Spatial And Temporal Variability In The Earth's Radiative Fluxes Through Analysis Of Ceres, MODIS, AIRS, And ISCCP Data

Chin, Mian Goddard Space Flight Center

A Global Model Analysis of Anthropogenic Aerosol Radiative Forcing Using Data from Terra and Aqua Satellites, Ground-Based Networks, and In-Situ Measurements

Christopher, Sundar University of Alabama Huntsville

A Multi-Sensor Approach for Estimating Global Aerosol Radiative Forcing from Terra and Aqua

Crosson, William Marshall Space Flight Center

Improving Weather Forecasts by Assimilating EOS Satellite Data

Del Genio, Anthony Goddard Institute for Space Studies

Why Can't Global Climate Models Simulate ENSO Variability?

Dutton, Ellsworth National Oceanic and Atmospheric Administration

Sustained Network-Based Observations of Surface Radiation Budget Components and Related Parameters for the Validation of EOS Products

Entekhabi, Dara Massachusetts Institute of Technology

Global Estimates of Evaporation from Variational Assimilation of Multi-Platform Land Surface Temperature into a Dynamic Model of the Surface Energy Balance

Hsu, N. Christina Goddard Space Flight Center

Retrieving Aerosol Properties over Bright-Reflecting Surfaces: An Extension of Current MOD04/MYD04 Products

King, Michael Goddard Space Flight Center

Remote Sensing of Cloud Optical and Microphysical Properties and Gridded Atmosphere Products from MODIS: An Algorithm Refinement Proposal

Lacis, Andrew Goddard Institute for Space Studies

Aerosol Climatology for GCM Applications Using MODIS, MISR, and POLDER Data

Moncet, Jean-Luc Atmospheric and Environmental Research Incorporated

Monitoring of Global Microwave Land Surface Emissivities and Temperature Derived from Combined AMSR-E, AMSU/AIRS, and MODIS

Petersen, Gary Pennsylvania State University

Applying MODIS Estimated Radiation Budget and Biophysical Parameters with Multi-Scale Soils and Weather Data for Crop Yield Modeling

Schaaf, Crystal Boston University

Algorithm Refinement for the MODIS Bi-Directional Reflectance/Albedo Product

Stackhouse, Paul Langley Research Center

Fast Longwave and Shortwave Fluxes (FLASHflux) for Surface and TOA from Global CERES and MODIS Observations

Xu, Kuan-Man Langley Research Center

Implementation and Vigorous Evaluation of a Super Parameterization Approach Using EOS Satellite Cloud, Radiation and Precipitation Data

Wiscombe, Warren Goddard Space Flight Center

Perfecting Sunlint Models with Polarization for Advanced Earth and Space Science Applications

CAN-02-OES-01 “Earth Science REASoN – Research, Education, and Applications Solutions Network, A Distributed Network of Data and Information Providers For Earth Science Enterprise Science, Applications and Education.”

Bosilovich, Michael NASA Goddard Space Flight Center

The Development of a Multiyear Global Assimilated Dataset for Weather and Climate Variability and Prediction Studies with a Focus on the Hydrological Cycle

Rossow, William Goddard Institute for Space Studies

Variability of Global Cloud Property Distributions from Diurnal to Decadal Time Scales: Continuation of Data Analysis for the International Satellite Cloud Climatology Project (ISCCP)

Additional SMD Funded Activities

Stackhouse, Paul NASA Langley Research Center

The NASA/WCRP-GEWEX Surface Radiation Budget (SRB) Project: Developing and Assessing 20-years of Global SRB Using EOS Observations and Aerosol Modeling

Appendix E. Acronyms and Websites

ACRONYMS:

AIA	American Institute of Architects
AIRS	Airborne Infrared Sounder
AMSR-E	Advanced Microwave Scanning Radiometer-EOS (Japanese)
AMSU	Advanced Microwave Sounding Unit
ARM	Atmospheric Radiation Measurement Program
ASA	Aerospace States Association
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
BSRN	Baseline Surface Radiation Network
CALIPSO	Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations
CAN	Cooperative Agreement Notice
CANMET	Canadian Meteorological Service
CCSP	Climate Change Science Program
CCTP	Climate Change Technology Program
CEDRL	Canadian Energy Diversification Research Laboratory
CERES	Clouds and the Earth's Radiant Energy System
CREST	Center for Renewable Energy and Sustainable Technology
DAO	Data Assimilation Office
DHS	Department of Homeland Security
DICE	Dynamic Integrated Climate Economy
DOD	US Department of Defense
DSS	Decision Support Systems
DST	Decision Support Tool
EIA	Energy Information Administration
EPA	US Environmental Protection Agency
EPRI	Electric Power Research Institute
ESMF	Earth Science Model Framework
FEA	Federal Enterprise Architecture
FLASHflux	Fast Longwave and Shortwave Fluxes
FMS	Flexible Modeling System
fvCAM	Finite-volume Community Atmospheric Model
GCM	Global Climate Model
GEO	ad hoc Group on Earth Observations
GEOS	Global Earth Observation System of Systems
GEWEX	Global Energy and Water Cycle Experiment
GFDL	Geophysics Fluid Dynamics Laboratory
GIFTS	Geosynchronous Imaging Fourier Transform Spectrometer
GIG	Global Information Grid
GMAO	Global Modeling and Assimilation Office
GMES	Global Monitoring for Environment and Security
GOCART	Global Ozone Chemistry Aerosol Radiation Transport
GOES	Geostationary Operational Environmental Satellite
GSFC	Goddard Space Flight Center
GVAP	Global Water Vapor Project
IBPD	Integrated Budget and Performance Document
IEA	International Energy Agency
INTEX	Intercontinental Chemical Transport Experiment
IPCC	International Panel on Climate Change

ISCCP	International Satellite Cloud Climatology Project
IWGEO	Interagency Working Group on Earth Observations
JCSDA	Joint Center for Satellite Data Assimilation
MISR	Multi-angle Imaging Spectroradiometer
MODIS	Moderate Resolution Imaging Spectroradiometer
MOU	Memorandum of Understanding
MSFC	Marshall Space Flight Center
NASA HQ	NASA Headquarters
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NCEP	National Centers for Environmental Prediction
NEMS	National Energy Modeling System
NESDIS	National Environmental Satellite Data Information Service
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-Orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Project/Net Primary Productivity
NRA	NASA Research Announcement
NREL	National Renewable Energy Laboratory
NSF	National Science Foundation
NSIPP	NASA Seasonal to Interannual Prediction Project
NSRDB	National Solar Radiation Database
NWS	National Weather Service
OAR	Office of Oceanic and Atmospheric Research
OES	Office of Earth Science
OMB	Office of Management and Budget
OSSE	Observing System Simulation Experiment
PART	Program Assessment Rating Tool
POES	Polar Orbiting Environmental Satellites
POLDER	Polarization and Directionality of Earth's Reflectance
R2O	Research to Operations Network
RAQMS	Regional Air Quality Modeling system
REASoN	Research, Education, and Applications Solutions Network
RET	Renewable Energy Technologies
SAIC	Science Applications International Corporation
SEA	State Enterprise Architecture
SMD	Science Mission Directorate
SRB	Surface Radiation Budget
SSC	Stennis Space Center
SSE	Surface meteorology and Solar Energy
SURFRAD	Surface Radiation
TERRA	Not an Acronym
TOA	Top Of the Atmosphere
TOMS	Total Ozone Mapping Spectrometer
TRMM	Tropical Rainfall Measurement Mission
UCAR	University Corporation for Atmospheric Research
UNEP	United Nations Environment Programme
USDA	US Department of Agriculture
WGA	Western Governors' Association
WMO	World Meteorological Organization
WRF	Weather Research and Forecast

WEBSITES:

EPRI: <http://www.epri.com>

HOMER: <http://www.nrel.gov/homer>

Renewable Energy Policy Project: <http://www.crest.org>

RETScreen International: <http://www.retscreen.net/ang/menu.php>

SSE: <http://eosweb.larc.nasa.gov/sse>

AIWG: <http://aiwg.gsfc.nasa.gov/>

Applied Sciences Program: <http://science.hq.nasa.gov/earth-sun/applications>

DEVELOP: <http://develop.larc.nasa.gov>

Earth-Sun System Gateway (ESG): <http://esg.gsfc.nasa.gov/>

Earth-Sun Science System Components: <http://www.asd.ssc.nasa.gov/m2m>

NASA FY2005 Budget: <http://www.ifmp.nasa.gov/codeb/budget2005>

Research and Analysis Program: <http://science.hq.nasa.gov/earth-sun/science/>

Science Mission Directorate: <http://science.hq.nasa.gov>

Science Strategies: <http://science.hq.nasa.gov/strategy/>